A SURVEY OF WATER QUALITY IN

DISTRIBUTION SYSTEMS:

YORK

AURORA PLANT

Ontario
Ministry
of the
Environment

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PART OF A SURVEY OF WATER QUALITY IN DISTRIBUTION SYSTEMS - 1981

REPORT ON YORK AURORA - JULY 16, 1981

INTRODUCTION

Much attention in the water treatment industry is paid to the production of high quality water as it leaves the treatment plant. It is often assumed that this high quality product is transmitted unchanged to the consumer's tap. However, during the hours, or in some cases days, that can elapse before the final use by the consumer, a number of changes can occur; while not usually health related, they can certainly effect the aesthetic quality.

The purpose of the survey was to examine the water quality in a cross section of distribution systems in Southern Ontario and determine any water quality changes that occurred.

Municipalities to be included were selected by staff of the Water Technology Section in consultation with M.O.E. regional staff and municipal staff. The selection criteria included differences in source water, treatment regimes, distribution system age, type and configuration, geographic location and suspected problem areas.

Two Experience '81 students and one Ontario-Quebec exchange student, under the direction of Water Technology Staff, sampled 28 municipal systems over a two month period, from the end of May to the end of July, 1981.

This eport deals exclusively with the results obtained during the survey of the York Aurora Water System taken on May 27, 1981, details of which are given in Table 1 and Figures 1 and 2.

METHODS

For each municipal system studied, samples were taken of the raw and treated water at the plant and usually at 5 consumers taps and 1 fire hydrant. The five consumers were usually chosen in consultation with the Public Utilities personnel to be representative of most areas in the distribution system, taking into account the distance from the plant, the age, type and size of main and the probable flow in the main. If possible a few sites were also examined if either asbestos cement pipe or lead service connections were in use.

At all sampling locations water from the tap or hydrant was allowed to flow to waste for 5 minutes prior to collecting samples or doing on site analysis. At the hydrant care was taken to keep the flow to about 4 L/s so as not to lift any sediment present in the main. If a lead service connection was in use, an "initial sample" was taken when the tap was first opened and subjected only to metals analysis.

The samples were taken in accordance to the procedures outlined in the M.O.E. publications "A Guide to the Collection and Submission of Samples for Laboratory Analysis" and "Asbestos Sampling Procedures".

(a) Chemical and Physical Parameters

During the sampling process, water was analysed, on site, for dissolved oxygen, pH and temperature using a "YSI" D.O. meter and a "IL" pH meter. Chlorine residuals were determined with a DPD comparator.

All laboratory analyses were carried out by the M.O.E. Laboratories Branch in the Toronto facilities according to published procedures in "Outlines of Analytical Methods".

(b) Bacteriology

Raw and treated water samples were analysed for fecal and total coliforms, background and the standard plate counts (where applicable) by the P-A and MF methods. If the P-A test was positive the samples were examined for other indicators of poor water quality.

(c) Macro-organisms

Small in-line filters were used to sample for macro-organisms at most sampling sites. The purpose of the sample was to identify the types of organisms, their numbers and possibly identify any other visible particles such as algae. The filter used was 47 mm in diameter with a pore size of 8 μm. The volume filtered depended on the particulate content of the sample and varied between 1-30 L. The residue on the filter paper was rinsed into a sample bottle containing sodium thiosulphate and stored on ice during transportation to the laboratory.

At the laboratory the sample was concentrated by centrifugation and examined in a Sedgewick-Rafter counting cell by a compound microscope. Usually all of the material could be examined in one slide.

A sample for biological analysis was also collected from a fire hydrant. Usually 4000 L was filtered for this sample. The pore size used was dependent on the water quality and varied between 1 and 75 μm. The purpose of the sample was similar to that of the in-line filters in terms of identification and quantification of organisms and visible particles. The increased volume filtered and the increased flow at the hydrant would be more likely to show the complete population of the main which may not be evident from the smaller in-line filters taken at the consumer's tap.

In the field the hydrant sample residue on the filter was washed into jars; sodium thiosulphate was added and the jars stored on ice. In the laboratory the sample was filtered through a 180 μm sieve, which separated off the large organisms. This residue was examined both with and without a dissecting microscope and the organisms identified and quantified. The filtrate from the sieve, or usually just a portion, since there was usually a large amount of material, was concentrated by centrifugation and examined in a Sedgwick-Rafter counting cell with a compound microscope.

RESULTS AND DISCUSSION

Basically two approaches were taken when examining the water quality. First the raw and treated waters were compared to find any significant changes across the treatment system. Secondly, the water quality leaving the treatment plant was compared with the quality at each distribution system location to ascertain if any changes had occurred after leaving the treatment plant.

The acceptability of the water quality was judged on the limits set out in the Drinking Water Objectives of Ontario, 1982. Changes were judged on the basis of the precision of the analysis as specified in MOE publication "Outlines of Analytical Methods".

a. Chemical and Physical Parameters

Comparison of raw and treated values showed consistency with most of the physical and chemical parameters. There was an increase in colour above the recommended value of 5 at 53 Aurora Heights and 8 Dodie St. (Table 2), which may be associated with the low flow in dead end mains.

Throughout the water system there was generally little change in metal concentrations. The iron concentration of the treated water was above the recommended level of 0.3 mg/L (Table 4). The limit was also exceeded in the distribution system but this was sequestered iron; since sodium silicate was added during treatment. There was a slight drop in the iron concentration at 22 Wenderly and 8 Dodie Street which were on dead end mains, indicating that some iron had settled out but the sequestering was generally effective.

The asbestos concentrations were consistently low throughout the system (Table 5). The ASTM-500 Index indicates that this water is non-aggressive.

b. Bacteriological

The results of the bacteriological samples taken of the treated water

at the plant and out in the system indicated good quality, with no indicator bacterial being found and low background counts (Table 7). There was no apparent regrowth of bacteria even though the relatively high initial chlorine residual was quickly depleted in the distribution system.

c. Macro-organisms

People who deal with water treatment plants and distribution systems are generally well conversant on the general chemical and physical parameters and the usual bacteriological test, but few know that higher forms of life are possible in distribution systems. When present at low numbers, they can only be detected by concentrating techniques. Macro-organisms are part of the normal fauna of water and do not constitute a health hazard but become an aesthetic problem when they are abundant.

In the total survey of 28 municipal water systems, macro-organisms were found in all distribution systems, both ground water and surface supplies. Nematodes, small worms usually less than a millimeter long, were found in all systems with an average number of 1.8/L. Copepods and cladocerans, swimming invertebrates 1 to 2 mm in length, were found in 11 and 13 municipal systems respectively of the 28 examined. Where present, their numbers averaged 0.5/L.

In the Aurora water system, nematodes were found in all samples of treated water and the numbers were relatively high, averaging 8.24/L (Table 8). The number at any one location was not associated directly with the chlorine residual since high numbers were found when it was present or not. It appears as if they are multiplying in the distribution system possibly in the sediments that are depleting the chlorine residual. At the one location that was swabbed almost a year before lower numbers were found but the even lower numbers at 22 Wenderly cannot be explained.

CONCLUSION AND RECOMMENDATIONS

Examination of the Aurora Water System on July 16/81 showed good

water quality in terms of physical, chemical and microbiological parameters and this quality was maintained from the treatment plant to the outlets of the ultimate consumers.

The only area warranting consideration of corrective measures is a reduction in the number of macroorganisms, specifically nematodes. As pointed out earlier, their presence does not constitute a health hazard and their small size, usually less than 0.5 mm and white colour, would make them very difficult to find under normal circumstances. A continuation of the swabbing, preferably all completed at the same time, should improve the situation by removing the accumulated sediments.

Table 1

General Information Date: July 16/81

Municipality: York Plant: Aurora

UTM No.: 17623004812400

MOE Works No.: 220002440

Engineer in charge:

Address:

Phone:

Operator: Doug Sewell

Address: Box 296, Newmarket

Phone: 895-7231

Plant Information

Raw Water Source: Wells

Max. Rated Flow (m^3/day): 25,500

Daily Flow Rate (m^3/day): 10,000

Plant Retention Time (hrs.): none to 10 min.

Municipality Information

Area (hectares): 4,947

Households (1979): 5,063

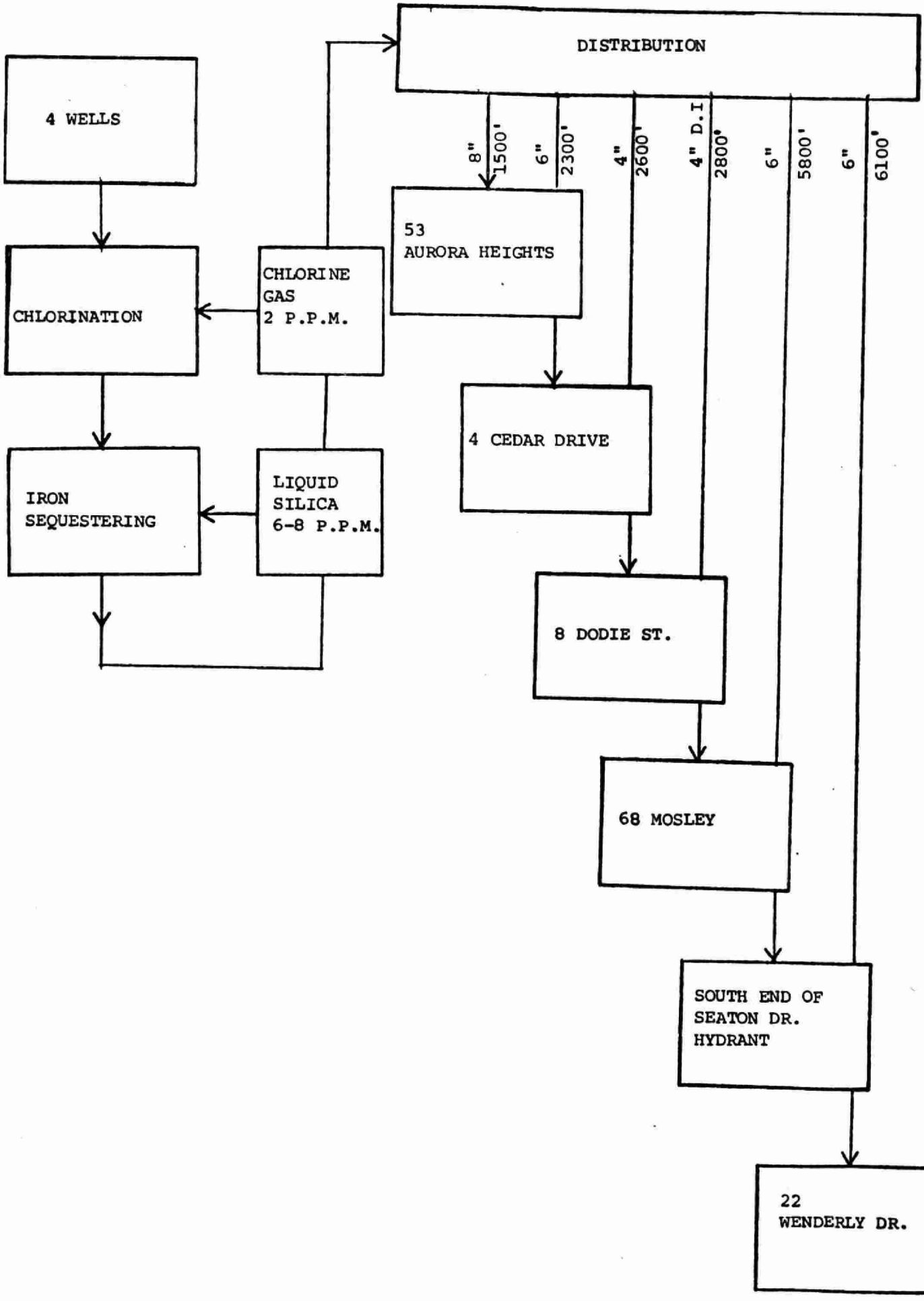
Population (1980): 15,792

Notes:

July 16/81

AURORA Fig. 1

WATER TREATMENT AND SAMPLE LOCATIONS



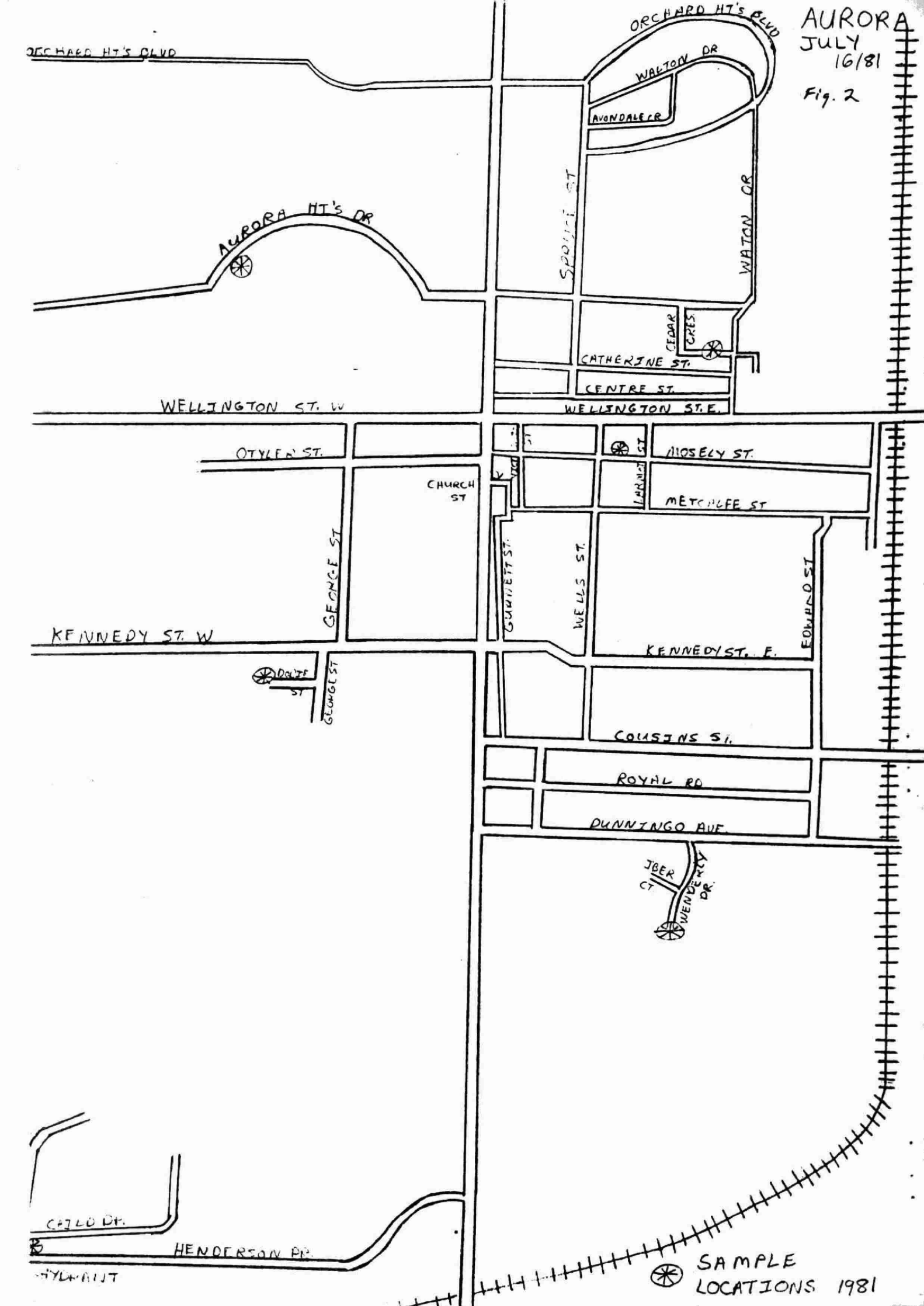

AURORA
JULY
16/81
Fig. 2
ORCHARD HT'S BLVD
WALTON DR
AVONDALE CR
SPRUCE ST
WATON DR
AURORA HT'S DR
CEDAR CRES
CATHERINE ST.
CENTRE ST.
WELLINGTON ST. W
WELLINGTON ST. E.
OTYLEA ST.
CHURCH ST
MOSELY ST.
METCALFE ST
GEORGE ST
GUNNETT ST.
WELLS ST.
EDWARD ST
KENNEDY ST. W
KENNEDY ST. E.
COUSINS ST.
ROYAL RD
DUNNINGO AVE
JBER CT
WENDERLY DR.
HENDERSON DR.
SAMPLE LOCATIONS 1981

TABLE 2

1981 Distribution Systems Study

Location: Aurora

Date: July 16/81

Analysis: Asbestos Support Chemistry (PCWTO9)

Parameters / Location	Well #1 Raw	Well #2 & 3 Raw	Well #1,2,3 Treated	68 Mosley St.	22 Wenderly	4 Cedar Cr.	53 Aurora Heights	8 Dodie St.		
Hardness ($CaCO_3$) (HARDT) (mg/L)	192	180	192	172	190	188	196	192		
Alkalinity ($CaCO_3$) (ALKT) (mg/L)	192						198	201		
PH	8.3	8.1	8.2	8.2	8.2	7.10	7.9	8.3		
Colour (COLAP) (TUC)	0				0	2.7	6.8	8.1		
Turbidity (F.T.U.) (TURB)	0.80				1.90	0.24	1.90	1.1		
Conductivity (umhos/cm) (COND 25)	350	299	370	325	356	338.0	361.0	355		
Total Residue (RST) (mg/L)										
Calcium (Ca) (CAUR) (mg/L)	51	48	49	42	50	49	50	51		
Magnesium (Mg) (MGUR) (mg/L)	16	15	17	16	16	16	17	16		
ASTM-500 Index	12.69						12.30	12.71		
Langelier's Index	-0.32						0.08	-0.34		

CORROSION INDICES

ASTM-500

<10	aggressive
10-12	moderately aggressive
>12	non-aggressive

Langelier

positive - tendency to deposit scale

negative - tendency to dissolve scale

TABLE 3

1981 Distribution Systems Study

Location: Aurora

Date: July 16/81

Analysis: Distribution System Support Chemistry (PCWT 10)

Parameters / Location	Well #1 Raw	Well #2, 3 Raw	Well #1,2,3 Treated	68 Mosley St.	22 Wenderly	4 Cedar Cr.	53 Aurora Heights	8 Dodie St.			
Total Ammonium (NNHTFR) (mg/L)											
Total KJELD Nitrogen (NNTKUR) (mg/L)	0.6	0.4	0.4	0.2	0.2	0.4	0.4	0.2			
Nitrite (NNO2FR) (mg/L)	<0.01	<0.01	<0.01	0.05	0.01	0.01	<0.01	0.01			
Nitrate (NNO3FR) (mg/L)	<0.1	<0.1	<0.1	0.1	0.2	<0.1	<0.1	0.2			
Total Phosphorus (PPUT) (mg/L)	<0.1	<0.1	<0.1	0.2	0.2	<0.1	<0.1	0.2			
Dissolved Organic Carbon (DOC) (mg/L)	1.1	1.1	1.0	0.9	0.8	0.9	0.9	0.9			
Silicate (SIO3UR) (mg/L)	0	0	0	0	0	0	0	0			
Sulphate (SSO4UR) (mg/L)	2	2	2	2	2	2	2	2			
Fluoride (FFIDUT) (mg/L)	0.15	0.13	0.15	0.14	0.14	0.14	0.13	0.13			

Remarks:

TABLE 4

1981 Distribution Systems Study

Location: Aurora

Date: July 16/81

Analysis: Metals (PCWTO8)

Parameters / Location	Well #1 Raw	Well #2, 3 Raw	Well 1,2,3 Treated	68 Mosley St Initial	68 Moseley St	22 Wenderly	4 Cedar Cr.	53 Aurora Heights	8 Dodie St. Initial	8 Dodie St.
Aluminum (Al) (ALUT) (mg/L)	0.1	0.098	0.110	0.100	0.100	0.110	0.110	0.110	0.11	0.10
Barium (Ba) (BAUT) (mg/L)	0.005	0.057	0.057	0.055	0.055	0.056	0.057	0.063	0.056	0.056
Cadmium (Cd) (CDUT) (mg/L)	0.0004	0.0004	0.0005	0.0005	0.0005	0.0006	0.0004	0.0004	0.0006	0.0005
Chromium (Cr) (CRUT) (mg/L)	0.002	0.002	0.002	0.003	0.003	0.002	0.002	0.002	0.002	0.002
Cobalt (Co) (COUT) (mg/L)	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Copper (Cu) (CUUT) (mg/L)	0.002	0.004	0.011	0.004	0.004	0.046	0.049	0.035	0.046	0.008
Iron (Fe) (FEUT) (mg/L)	0.12	0.26	0.74	0.53	0.53	0.30	0.63	0.72	0.30	0.37
Lead (Pb) (PBUT) (mg/L)	0.005	0.003	0.004	0.004	0.004	0.004	0.003	<0.003	0.004	<0.003
Manganese (Mn) (MNUT) (mg/L)	0.028	0.02	0.038	0.026	0.026	0.014	0.036	0.038	0.014	0.014
Molybdenum (Mo) (MOUT) (mg/l)	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002
Nickel (Ni) (NIUT) (mg/L)	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Zinc (Zn) (ZNUT) (mg/L)	0.001	0.004	0.002	0.001	0.001	0.002	0.003	0.002	0.002	0.002

Remarks:

TABLE 5

1981 Distribution System Study

Location: Aurora

Date: July 16/81

Analysis: ASBESTOS (ASBESW)

PARAMETERS * / LOCATION	Well #1 Raw	Well #2,3 Raw	Well #1,2,3 Treated	68 Mosley St.	22 Wenderly	4 Cedar Cr.	53 Aurora Heights	8 Dodie St.			
Chrysotile Fibres - Total (FIBCT)	<0.2	<0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Chrysotile Fibres - Lower Limit (FIBCTL)	0	0	0	0	0	0	0	0			
Chrysotile Fibres - Upper Limit (FIBCTU)	<0.2	<0.2	<0.1	<0.3	<0.1	<0.1	<0.1	<0.1			
Amphibole Fibres - Total (FIBAT)	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1			
Amphibole Fibres - Lower Limit (FIBATL)	0	0	0	0	0	0	0	0			
Amphibole Fibres - Upper Limit (FIBATU)	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1			
Total Asbestos - (FIBCT + FIBAT)	<0.4	<0.4	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2			
Other Fibres - Total (FIBOT)	<0.2	<0.2	<0.1	<0.1	0.3	<0.1	<0.1	<0.1			

* All fibres x 10^6/L

TABLE 6

1981 Distribution Systems Study

Location: Aurora

Date: July 16/81

Analysis: Field Analysis

Parameters / Location	Well #1 Raw	Well #2, 3 Raw	Well #1,2,3 Treated	68 Mosley St.	22 Wenderly	4 Cedar Cr.	53 Aurora Heights	8 Dodie St.	Hydrant Seaton Dr.		
Type of Main				DI							
Service Con.				Pb							
Temp. (^{o}C)	14	10	11	15	18	13	12	18	16		
PH	7.2	7.3	7.5	7.2	7.1	7.2	7.2	7.0	6.9		
Chlorine: Free	-	-	0.8	T	0	0.3	0.4	0	0		
Combined	-	-	3.2	0.1	T	0.2	0.3	0	0		
DO (mg/L)	0.7	0.9	5.7	2.1	1.8	4	5	2.1	3		

LEGEND

C.I. - GREY CAST IRON
D.I. - DUCTILE CAST IRON
A-C - ASBESTOS CEMENT
PLAS - PLASTIC
Pb - LEAD
Cu - COPPER
GAL - GALVANIZED
T - TRACE CHLORINE RESIDUAL

TABLE 7

1981 Distribution System Study

Location: Aurora

Date: July 16/81

Analysis: BACTERIOLOGICAL

PARAMETERS / LOCATION	Well #1 Raw	Well #2, 3 Raw	Well # 1,2,3 Treated	68 Mosley St.	22 Wenderly	4 Cedar Cr.	53 Aurora Heights	8 Dodie St.	Fire Hydrant Seaton St.		
Fecal Coliform (MF)/100 mL	<2						<2	<2			
Total Coliform (MF)/100 mL	<2	0	0	0	0	0	<2	<2	0		
Background (TCMF)/100 mL	<2	0	0	0	0	0	<2	6	10		
Fecal Strep. (MF)/100 mL	<2						<2	<2			
Standard Plate Count/mL											
Present/Absent Test		ABS	ABS	ABS	ABS	ABS			ABS		
Fecal Coliform (P/A)											
Total Coliform (P/A)											
Fecal Strep. (P/A)											
Staph. aureus (P/A)											
Aeromonas (P/A)											
Pseudomonas aerug (P/A)											
Clostridium perf. (P/A)											

TABLE 8

1981 Distribution Systems Study

Location: Aurora

Date: July 16/81

Analysis: BIOLOGICAL CONTENT (INLINE FILTER)

PARAMETERS / Location	Well #1 Raw	Well #2, 3 Raw	Well #1,2,3 Treated	68 Mosley St.	22 Wenderly	4 Cedar Cr.	53 Aurora Heights	8 Dodie St.	Fire Hydrant Seaton St.		
Volume filtered (L)	6.0		22.0	16.0	16.0	18.0	18.0	8.0	4.3		
Nematodes/L	0		0.32	18.0	0.75	20.83	14.67	1.88	10.19		
Copepods/L	0		0	0	0	0	0	0	0		
Cladocera/L	0		0	0	0	0	0	0	0		
Other Material											
Rotifers/L			0.05			0.27	0.17	1.00			
Watermite/L				0.06							
Active Protozoa									x		
Algae	x				x		x	x	x		

Remarks: